NAVAL SUBMARINE MEDICAL RESEARCH LABORATORY

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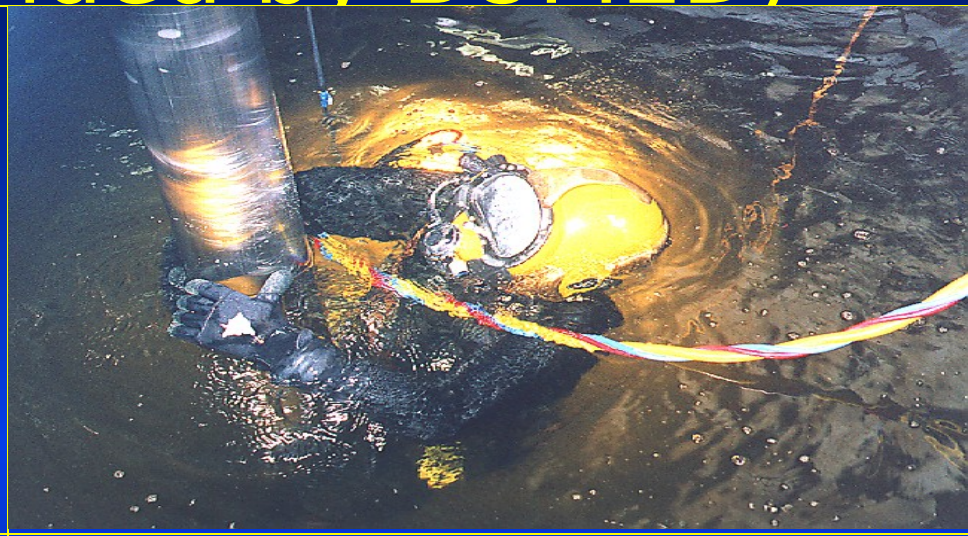
Our Mission: To Protect the Health and Enhance the Performance of our War Fighters Through Focused Submarine, Diving and Surface Research Solutions

Dive Station Work-site Noise Surveys (Funded by BUMED)

Naval Relevance

- Underwater tools are a source of high levels of noise for divers.
- Navy divers are also exposed to high noise levels on the surface.



Project Goals

- To develop valid and reliable methods & procedures for obtaining in-water noise measurements
- To obtain total diver noise dose (total in-water dose + total in-air dose)
- Develop comprehensive and quick-do Underwater/Topside SLM Manuals for use by Navy divers.
- Provide curriculum elements for diver training to NAVSEA & NDSTC

Rationale for Study

- Navy diver performs a diverse array of job functions as part of ship/submarine husbandry, salvage, and construction.

- In-water and in-air noise exposure

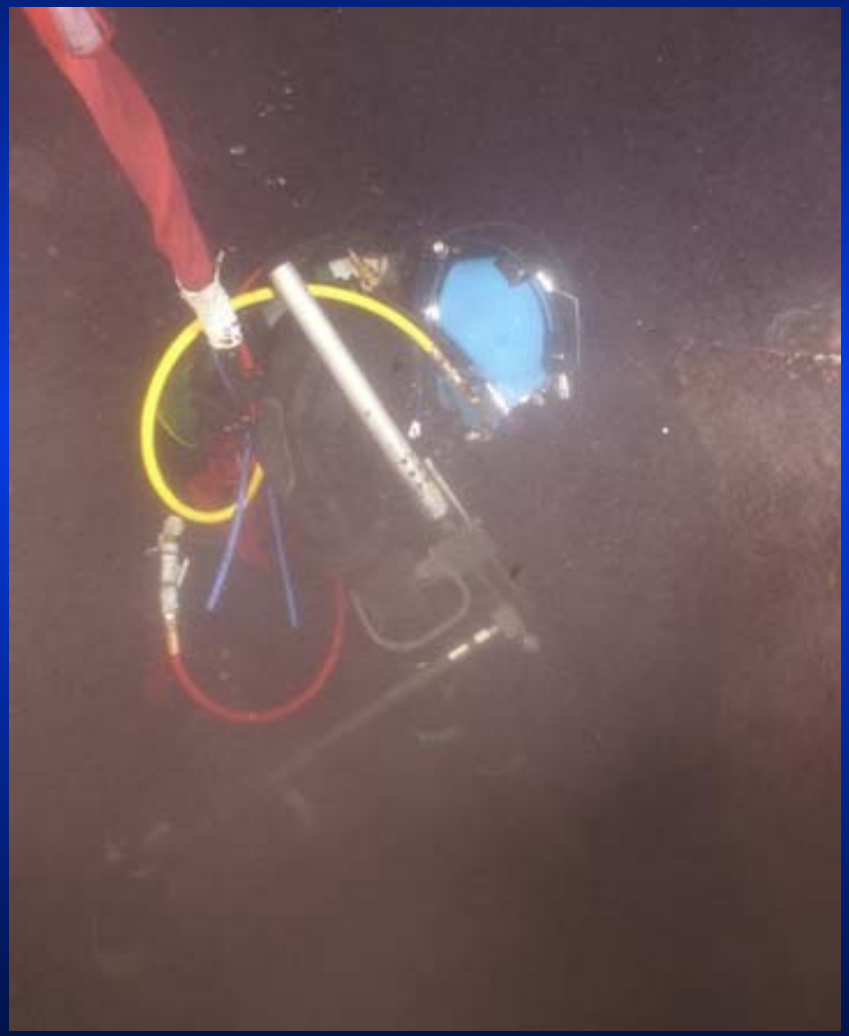
Portable Sound Measurement System

Methods and Procedures

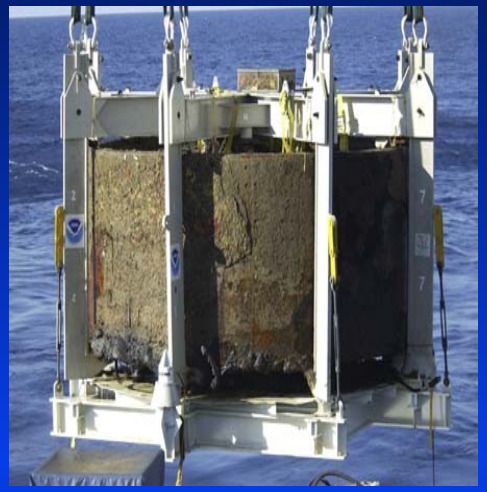
- Hydrophone attached to diver's helmet or to tool line
- Hydrophone distance from noise source **typically known**
- Octave Band (125-8 kHz, dB (L), and dB (A) measures
- In-air measures taken using same SLM

Hydroblaster Results (Salvage)

- 20K psi hydroblaster used during the USS MONITOR gun turret recovery (Jul 02)
- Non-ANU tool
- Hydrophone attached to tool line
- Measurements taken at 230 fsw with SLM on surface



Hydroblaster Results (Salvage)



- Russell (1994) **NPEL** for 8K psi hydroblaster : **85 minutes/94 dB(A)**
- Current study **NPEL** for 18K psi hydroblaster: **42.5 minutes/98 dB (A) (58%)**
- Existing ops schedule of **45 minutes** (50% duty cycle, more conservative)

Hydroblaster: Topside Noise

Noise Levels

- **83 to 99.9 dB (A)**
- Noise Dose w/o HPDs = **184 to 441%** (Observed dose of 225 min. divided by NPEL of 51-122 min.)
- Noise Dose with Earmuffs **negligible**
- Noise Dose with single protection = **52%**

Total Noise Dose = 58% (in-water) + 52% (in-air) or 110%

Noise Sources

- Hydroblaster Compressor
- Saturation Diving Launch and Recovery
- Saturation Chamber Compressor
- Morgan Crane Winch (Dive Station)
- 5000 psi Compressor System

USS ARIZONA (Structural Integrity)

USS ARIZONA Results

- Non-ANU approved tool (hydraulic drill press)
  - **In-water Noise Dose = 27%** (Observed dose of 90 min. divided by NPEL of 332 min.)
- Topside Portable Compressor (HPU)
  - **100 dB (A)**
  - **Topside Noise Dose = 300% (**Observed Dose of 90 min. divided by NPEL of 30 min.)

Total Noise Dose = 327 % in 24 hour period w/o HPDs

With use of insert HPDs: 21% + 27% = 48%

Underwater Construction

- **Public Works Divers, San Diego & Navy Diving and Salvage Training School**
  - Hydraulic Hammer Drill (Impulse Noise)
    - **In-water Noise Dose = 50%**
  - Grinder (Continuous Noise)
    - **Noise Dose = 2%**

Underwater Construction

- Friction stud welder (Impulse Noise)
- For SCUBA divers (in-water exposure): **154.4 dB re: 1$_{\mu}$Pa (In BBAT)**
- **Noise Dose = 38%** (Observed Dose of 3 hours divided by NPEL of 480 min.)

Aquarius Undersea Habitat/Lab

Aquarius Undersea Habitat and Life Support Buoy

- Diver Recall System for SCUBA Divers
- In-water Exposure = **138.7 dB re: 1µ PA @ 10'** from speaker **(NPEL of 960 min.)**
- **Recall level 113.2 dB 900' from speaker**
- In-air Exposure = **94.6 dB (A)** for LSB compressor **and 105.6 dB (A)** for diesel generator **(NPEL of 11.5 min.)**

❖ **Typical Diver LSB exposure 30-60 min.**

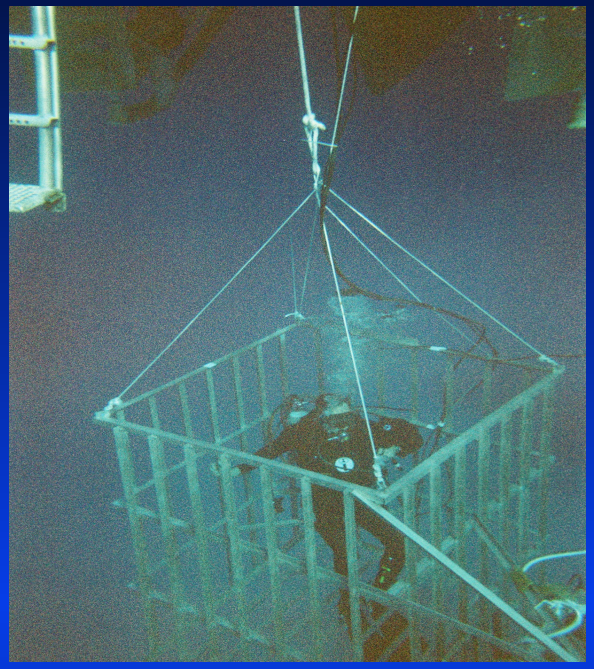
Products

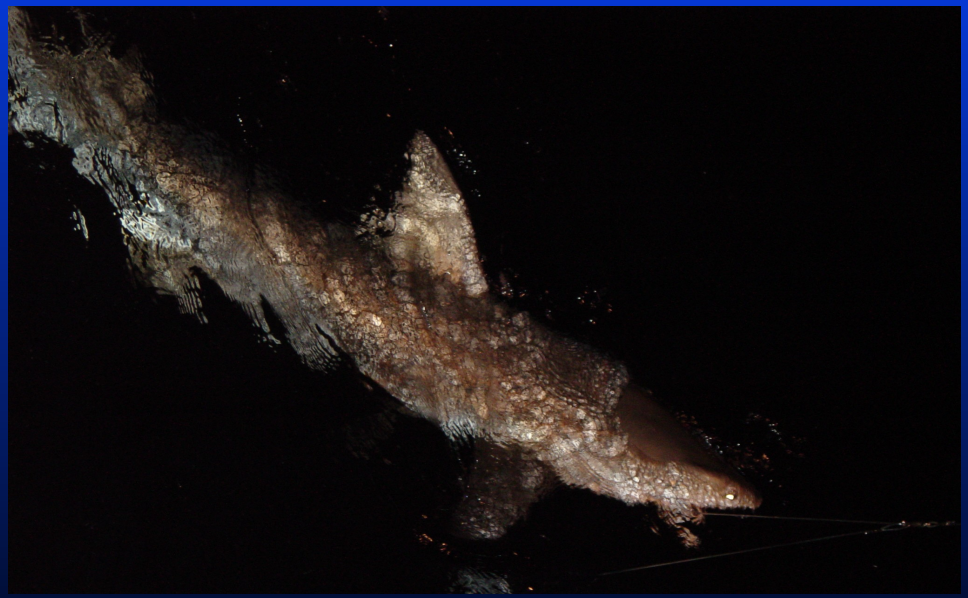
- **Valid and reliable** procedure for measuring in-water noise levels for helmeted and SCUBA divers
- **On-site Dosages/NPELs** provided for non-ANU tools
- Non-research divers used system to obtain in-water measurements
- **Estimated total noise exposure** obtained for sample of high noise dive scenarios.
- **Navy Technical Report** and **Curriculum Elements** being written and **underwater measurement systems** are available for fleet use

Recommendations

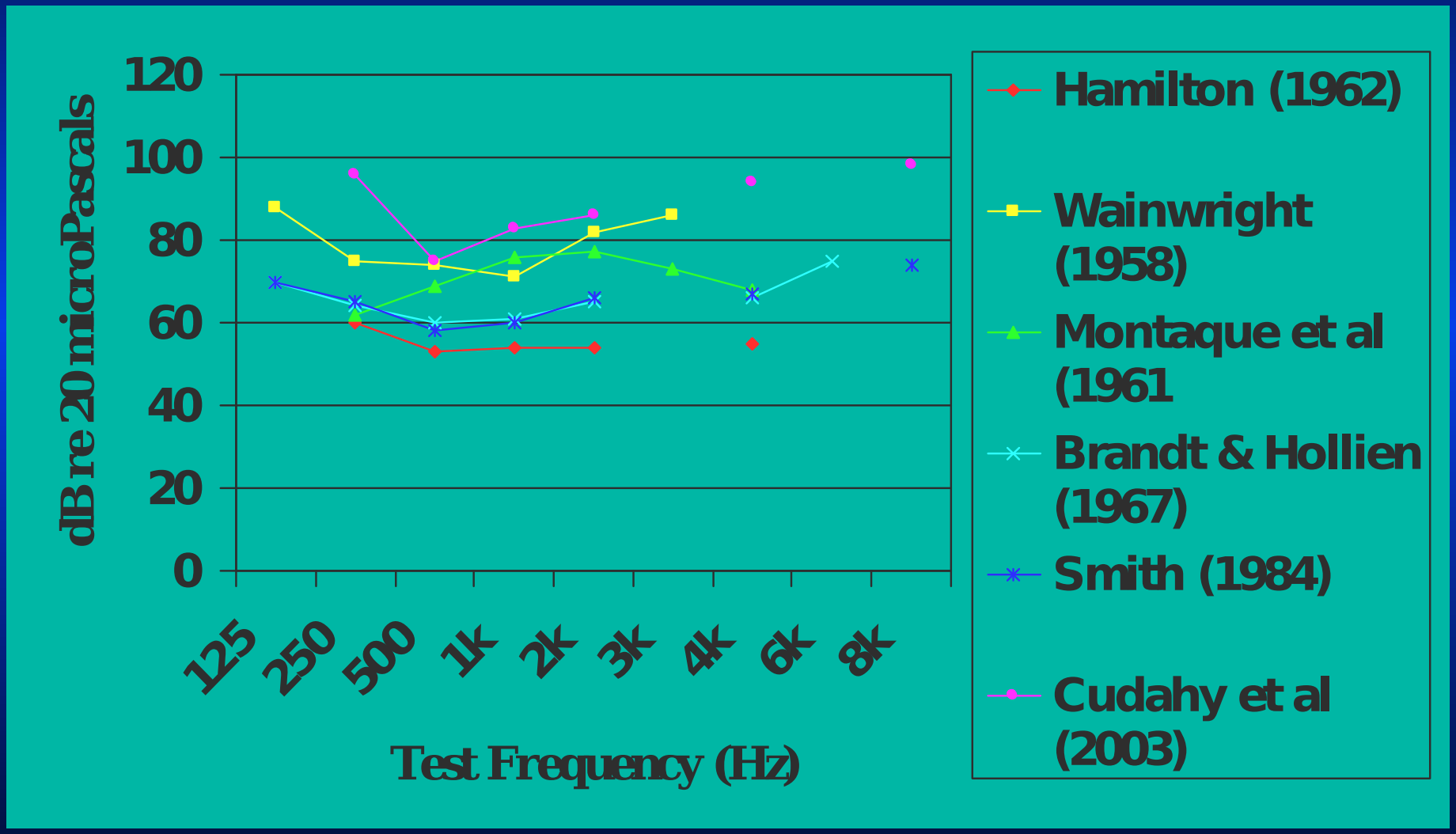
- Underwater noise data can be collected to compare to guidance
- Additional underwater data from salvage, ship repair, and underwater construction scenarios needed (central database)
- Navy divers should be trained to perform measurements

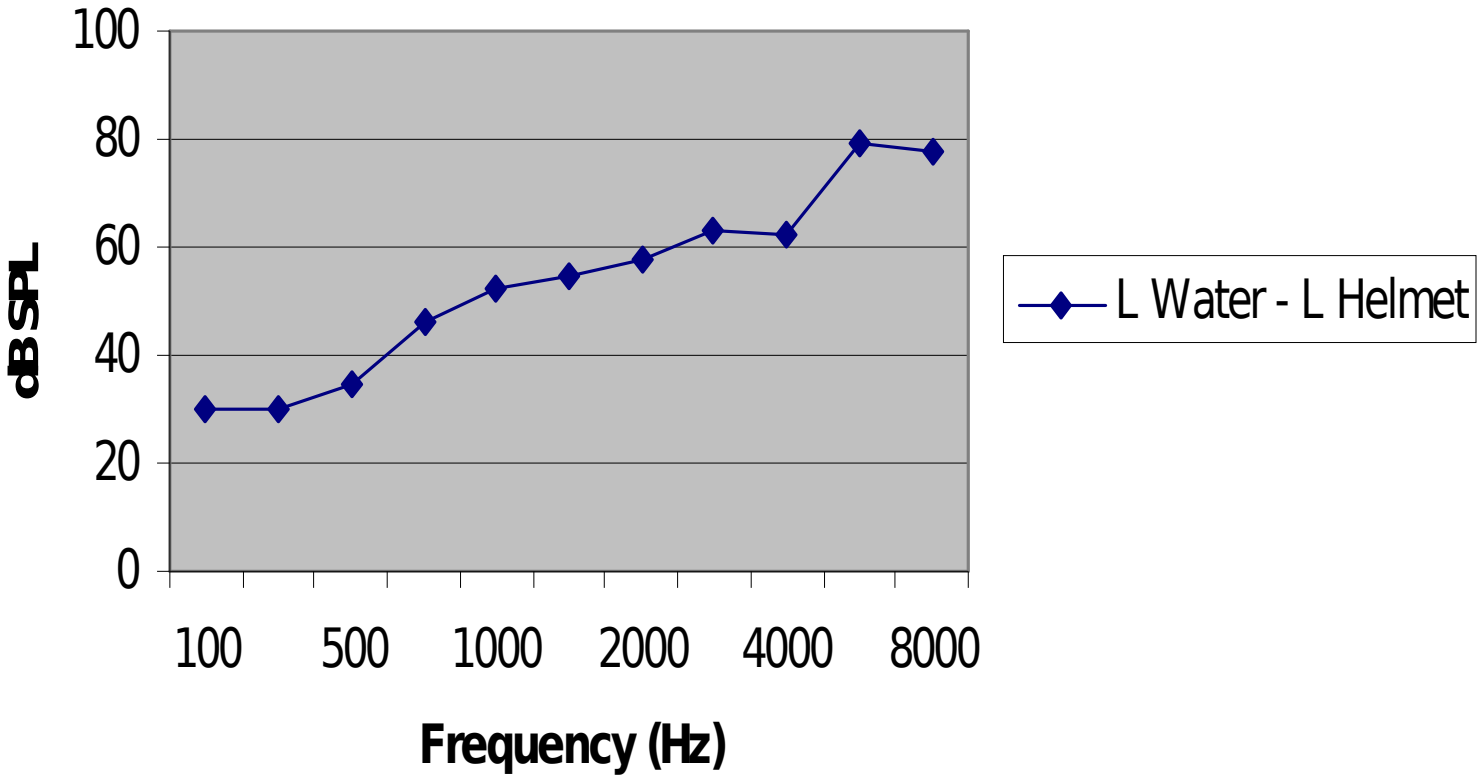
Naval Submarine Medical Research Laboratory





In-water Hearing Thresholds




Transfer Characteristic for MK21 Diving Helmet
(Russell, 1994)
dB SPL
100
80
60
40
20
0
100
500
1000
2000
4000
8000
Frequency (Hz)
L Water - L Helmet